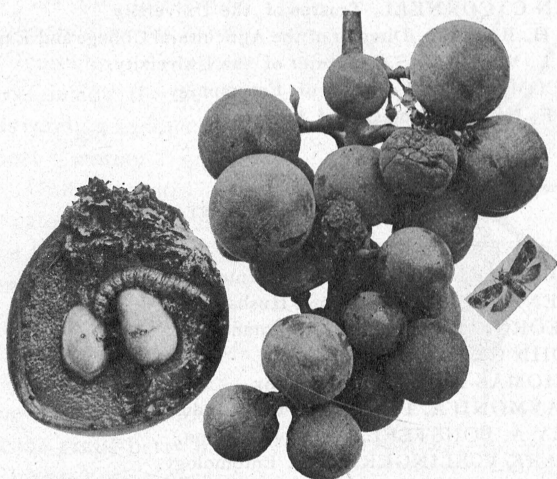


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CORNELL UNIVERSITY  
AGRICULTURAL EXPERIMENT STATION OF  
THE COLLEGE OF AGRICULTURE  
Department of Entomology (Extension Work)

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# The Grape-Berry Moth



By M. V. SLINGERLAND

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## THE GRAPE-BERRY MOTH

Order LEPIDOPTERA ; family TORTRICIDÆ

*Polychrosis viteana* Clemens

Most vineyardists are familiar with "wormy" grapes. In America the "rogues' gallery" of insect pests now includes three different kinds which have been known to infest grape berries and thus produce "wormy" grapes.

The maggot of a minute Chalcis-fly works in the seeds inside the berries, causing them to shrivel in August ; it is known as the grape-seed insect (*Evoxysoma vitis*) and is widely distributed, but it rarely attracts attention by its injuries. In the Mississippi Valley the grub of a small beetle known as the grape curculio (*Craponius inaequalis*) works inside the berries in July, but it is rarely a serious pest. The cause of most "wormy" grapes throughout the United States and Canada is the caterpillar of a small moth—the grape-berry moth—which is always present in most vineyards and often in very destructive numbers.

The grape curculio probably does not occur in New York, and the grape-seed insect has never been injurious in the State. But the grape-berry moth has infested most New York vineyards for many years, often to a serious extent, and it is responsible for practically all the "wormy" grapes. For two or three years this insect has been unusually destructive in several vineyards in the famous Chautauqua grape region, sometimes more than half the crop being ruined. Although during this time we have made important and extensive investigations on the grape root-worm and the grape leaf-hopper (see Bulletins 184, 208, 224 and 215) in Chautauqua vineyards, the grape-berry moth also has been studied with many interesting and important results. Our observations, extending over nearly two years and following a complete yearly life-cycle of the insect, have revealed new facts in its life-history ; we have demonstrated that it is a native American insect, and not the European grape-berry moth, which all have believed it to be for the past thirty-five years ; and

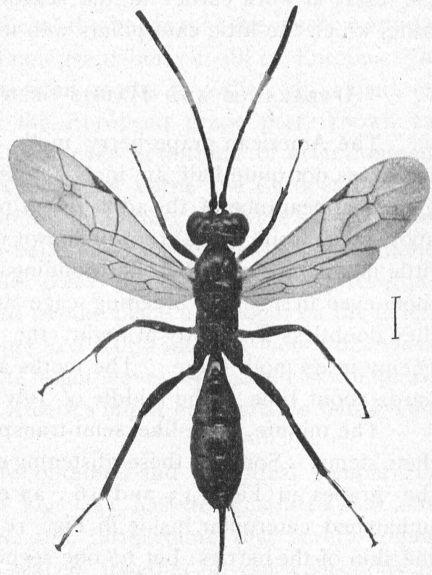


FIG. 12.—*Bathymetis* sp., parasite enlarged ; hair-line at side represents natural length. (See page 52.)

through coöperative experiments with several vineyardists in the infested region, we have found practicable and effective methods for controlling the insect.

#### INDICATIONS OF THE PRESENCE OF THE GRAPE-BERRY MOTH

Fortunately the vineyardist can easily and surely detect the presence of this insect. Its "signboard" is a purplish spot on the half-grown green berries, which often crack open, as is well shown in Fig. 13. Such spots mean that inside the berry the little caterpillar of the grape-berry moth is at work. No other enemy of the grape in New York state has quite such a "signboard" to indicate its presence. The close observer may also find the insect at work earlier in the season in the clusters of blossoms or young fruits which the little caterpillars web together, as shown in Fig. 19.

#### APPEARANCE AND HABITS OF THE INSECT BRIEFLY DESCRIBED

The American grape-berry moth is a small purplish-brown moth which measures not quite half an inch across its outspread wings. The size and general appearance of the adult insect or moth, and the peculiar shaded brown spots on its front wings are well shown in Figs. 15 and 20. So much do these little moths resemble their surroundings when at rest, that it is difficult to find them even in a small breeding cage among pieces of grape vines. And as they doubtless fly mostly at night, the vineyardist will rarely see this grape enemy in its moth stage. The moths are most numerous in New York vineyards about June 1, the middle of July, and again in August.

The minute, scale-like, semi-transparent eggs are stuck onto the berries or their stems. Some of these glistening eggs show like minute, whitish spots on the grapes in Figs. 13 and 16; an egg is shown much enlarged with the unhatched caterpillar inside in Fig. 16. The eggs are not difficult to find on the skin of the berries, but no one seems to have seen them before this time.

In June the little caterpillars which hatch from the eggs of the moths feed among the blossoms or recently-set fruits of the grape clusters, as shown in Figs. 17 and 19. Later in the season when the berries are larger, the caterpillars live inside the berries (Fig. 14) on the pulp and seeds, often going into a second or third berry. They get their growth in from three to four weeks, when they are about three-eighths of an inch long and vary in color from dark greenish to dark purplish with a light brown head and blackish thoracic shield. The arrangement of the sparse covering of whitish hairs and other details are well shown in the enlarged pictures of three full-grown caterpillars in Fig. 18. This grape-berry moth is injurious only during its life as a caterpillar.

When through feeding, the caterpillars leave the berries and cut curious little flaps from the leaves which they pull over and fasten, and inside this they spin a thin, white, silken cocoon. Several of these interesting cocoons were made

on the leaf shown in Fig. 22. Two to four days later, the caterpillar transforms in these cocoons into the light greenish-brown pupa, shown enlarged in Fig. 21. During the two weeks spent in this mummy-like pupa state in the summer, the insect is made over or transformed into the adult form—the pretty purplish-brown moth shown in Figs. 15 and 20. After about Aug. 15 all the pupæ hibernate and transform into the moths the next May or June.

There are thus four life-stages in the development of the grape-berry moth—the scale-like eggs (Figs. 13 and 16), the destructive caterpillars (Figs. 17 and 18), the mummy-like pupa (Fig. 21), and the richly colored little moths (Figs. 15 and 20).

#### IT IS NOT AN EUROPEAN INSECT

For nearly thirty-five years it has been the belief that the insect working in the American vineyards was the common grape-berry moth of Europe. In 1870, Dr. Riley sent some of the American moths to Zeller, an expert in Prussia, who reported that they were the European grape pest, known as *Eudemis botrana*.<sup>\*</sup> No one seems to have ever confirmed or even doubted Zeller's dictum and the American insect has since borne the European name.

In making a critical study of the literature in 1903, we were surprised to find that in European records the grape-berry moth pupæ hibernate in cocoons on the trunk of the vines or on the trellis posts, but in all American records, where hibernation is mentioned, it is said to take place in cocoons on the fallen leaves. After searching for several hours in a badly infested New York vineyard in autumn and finding cocoons on the fallen leaves, but none elsewhere, we suspected that the grape-berry moth of America might be after all a native and not a foreigner.

Some of the European moths were obtained and a critical comparison and study, as detailed later on (see Fig. 24), has demonstrated that our American moth is a different species, and furthermore that several other kinds of American moths have been placed together in our collections as the European grape-berry moth. In superficial appearance and in its habits our American grape-berry moth is much like the European species, but they are certainly distinct species and readily separable. We also find by breeding that the moth which frequently infests American wild grapes is the same as the one working in the vineyards; this is quite conclusive evidence that the insect is a native and not an imported species.

#### SOME HISTORICAL NOTES

The American grape-berry moth has been known since Clemens named the moth in 1860, but it was not recorded as injurious until 1868 in Ohio, Missouri and Pennsylvania. During the next year or two, it was destructively abundant in vineyards in Illinois and Maryland. The first record we have found of the insect in New York † states that

<sup>\*</sup> Riley in Am. Ent., ii, p. 273; and Zeller in Stett. Ent. Zeit., vol. 32, p. 178.

† Meehan's Gardener's Monthly, xv, 121.

it seemed to be increasing in the Hudson River Valley in 1873. In 1881, it was again abundant in Missouri and the next year in Ontario, Canada. There was a serious outbreak in Illinois again in 1884 and 1885, and in 1889 it was injurious in Delaware. It was apparently first recorded working in wild grapes in 1895 in Nebraska. From 1897 to 1899 one of our correspondents at Kendall, N. Y., reported serious injury in his vineyards from this insect, and it was also very destructive in northeastern Pennsylvania and Ohio vineyards. For the past two or three years the grape-berry moth has continued its destructive work in Ohio, Pennsylvania and Virginia; and in many vineyards scattered throughout the famous Chautauqua grape region a large percentage of the crop has been ruined by the insect.

#### DISTRIBUTION AND DESTRUCTIVENESS OF THE INSECT

The American grape-berry moth is widely distributed throughout the United States and Canada, probably occurring wherever the grape is grown to any extent, from the New England States to Florida and Texas and westward to California. It has been recorded in injurious numbers in Canada, Ohio, Illinois, Missouri, Pennsylvania, New York, Delaware, Maryland, Virginia and Texas.

This insect ranks first in destructiveness among the pests attacking the grape-berry. There have been but few definite estimates of the amount of injury by it. In 1869 it is said to have ruined fifty per cent of the fruit of certain varieties in Ohio, and in the same locality half the crop in many vineyards was rendered unmarketable in 1897 and 1898. A correspondent reported to us that the crop was entirely ruined by the insect in some vineyards in 1896 at Northeast, Pa. In 1903 the fruit in a Catawba vineyard of 16 acres in Ohio was so badly infested that it was unfit for use, even in making wine. The grape-berry moth is doubtless in most of the vineyards of the country every year, and the above records show that it is capable of ruining the crop of fruit.

*In New York.*—There are doubtless more or less "wormy" grapes each year in practically every vineyard in New York State, so that the grape-berry moth is a constant menace. But it seems seldom to have been injurious since 1873 when it was first reported as increasing in numbers in the Hudson Valley. In 1898 it was a serious pest in the vineyard of a correspondent at Kendall, N. Y., and in 1902 reports reached us of its ravages all through the Chautauqua grape belt. From portions of some vineyards near Brocton, a loss of from 25 to 50 per cent was reported, and in one case 90 per cent of the fruit was ruined. In 1903 and during the past year, the insect wrought equally as great destruction over a larger area in Chautauqua County. Many grape clusters were badly injured soon after the fruit was set, as shown in Figs. 17 and 19, and last July one could easily find clusters in badly infested vineyards with more than two-thirds of the berries "wormy." Thus the conditions are alarming in many vineyards in the Chautauqua region. In none of the other noted grape-growing sections of the state does the grape-berry moth seem to have attracted attention as a pest in recent years.

## THE FOOD-PLANTS OF THE GRAPE-BERRY MOTH

When the American grape-berry moth was first described and named by Clemens in 1860, he recorded the caterpillars as feeding on the fruit of the grape and wild raspberry, and on the leaves of sassafras. When the insect attracted attention as a grape pest in 1868, it was erroneously recorded as feeding on the leaves as well as the fruit of the grape\* and the error has clung tenaciously to the literature ever since. During the next thirty years, there was added to the menu of the grape-berry moth the following food-plants: blackberry blossoms† (Riley 1870), roses and *Vernonia* or ironweed (Murtfeldt, 1880 and 1882), tulip-tree leaves and swollen stems of *Amorpha* (Fernald, 1882), flower-buds of common thistle (Coquillett, 1883), berries of wild grape (Bruner, 1895), grape tendrils and blossoms, seed bunches of sumac, leaves of magnolia, phylloxera lice and their galls (Martlatt, 1896), and moths bred from flower-heads of thoroughwort or boneset and *Ambrosia trifida* have been classed with the grape-berry moth in collections. This is certainly quite a varied menu for a grape pest.

We have never seen the insect eat anything but grape blossoms, recently-set fruit, rarely the stem of clusters, and the green and ripening grapes. And a critical study of the supposed grape-berry moths in several collections has led an expert, Mr. W. D. Kearfott, to believe that those found feeding on most of the plants other than the grape are different species. A detailed account of Mr. Kearfott's interesting conclusions with illustrations is given on page 57. The case of sumac as a food-plant is especially important as it often grows freely in the vicinity of vineyards, and its destruction has been recommended as a help in the warfare against the grape-berry moth. Webster, however, bred many supposed grape-berry moths from seed bunches of sumac collected in 1898 with no vineyards near, and the seeds collected near seriously infested vineyards gave none of the moths. Now Mr. Kearfott finds that these sumac moths of Webster's are a distinct species from the grape feeder.

We expect that a thorough study of the supposed grape-berry moths which feed on other plants than the grape will reveal the fact that the true American grape-berry moth restricts its diet almost entirely to the blossom and fruit clusters of both the wild and cultivated grapes. Apparently no varieties are exempt from its attacks; those with tender skins and such as grow in compact bunches sometimes suffer most. The infested vineyards in the Chautauqua region are mostly Concords.

\* Packard first made this error (Am. Nat., II, p. 220, and part V, p. 336 of Guide to the Study of Insects) in 1863, but both Packard and Riley corrected it the next year (Am. Nat., III, p. 152, and Am. Ent., I, p. 177.) Yet the statement was never corrected in future editions of Packard's *Guide* and the insect has been said by nearly every writer to feed on grape leaves.

† Mr. W. D. Kearfott writes us that this blackberry feeder is a quite different moth known as *Ancylys muricana* Wlsm.

## THE LIFE-HISTORY OF THE INSECT

The life-history of the grape-berry moth has many interesting features, and we have been able to follow it through a complete yearly life-cycle during the past two years. We can now substitute definite facts for previous guesses and also add several chapters to its life-story.

*Hibernation.*—In Europe the grape-berry moth has long been recorded as hibernating in cocoons on the trunks of the vines, or on the trellis posts; but since 1868 it has been the common notion in this country that what was believed to be the same insect hibernated in cocoons on the fallen grape leaves. The loose bark on the vines or trellis posts affords ideal places for hibernation, but after several hours careful searching in such places in a badly infested vineyard in the autumn of 1903, we failed to find a single grape-berry moth. But we did find quite a number of the pupæ in their characteristic cocoons on the fallen leaves beneath the vines. This divergence in the hibernating habits in the two countries was easily explained when further study revealed the fact that the American grape-berry moth is not the European insect with similar habits, although very closely related to it.

The winter is always passed in the pupa state in the cocoon. We found most of the cocoons in the autumn on the damp and decaying leaves close to the ground under the vines, rather than on the drier leaves which are often blown into piles. There were also indications that some of the cocoons soon break away from the decaying leaves. These facts may explain why some have failed to breed the moths from leaves collected, probably from convenient piles in vineyards. In our breeding cages in autumn all the caterpillars spun their cocoons on the grape leaves rather than on the pieces of grape-vine, except one which cut its peculiar cocoon from a thin flap of the bark.

*Appearance and work of the spring brood.*—In a cage of hibernating pupæ that we kept outdoors, no moths appeared in the spring, and the pupæ got mouldy. But from pupæ kept in the warm insectary all winter, the moths were doubtless forced and began to emerge March 19 and continued until April 14. Thus we missed the normal time of emergence of the moths in the spring, but as recently-hatched caterpillars were found at work in the vineyards on June 17, some of the moths are doubtless flying by June 1, in the Chautauqua region. The eggs laid by these moths were not observed, but they are probably stuck on the stems of the blossom clusters.

Some of the caterpillars hatch and begin feeding before the grape blossoms open. They make a slight web among the blossom buds into which they eat, oftentimes destroying a dozen or more embryo grape-berries. The destructive work of this spring brood of caterpillars continues in June through the blossoming period and among the recently-set berries, as shown in Figs. 17 and 19.

One caterpillar may destroy more developing fruits in June than half a dozen caterpillars working in the larger berries later in the season. Yet this

spring brood of the grape-berry moth and its work rarely attract attention. This is doubtless largely because the slightly-webbed portions of the clusters of blossoms or young fruits do not make infested clusters especially conspicuous, and the spring brood is also comparatively small. In a vineyard badly infested in 1903, we found in June the next year not more than two or three caterpillars on a vine and many vines had no infested clusters. Three caterpillars were found in one cluster, and sometimes from one-third to one-half of the recently-set berries on a cluster were destroyed by a single caterpillar. The smallness of the spring brood is due largely to the efficient work of the many parasitic enemies of the insect the preceding year, doubtless aided often by unfavorable winter conditions.

We have never seen the spring brood of caterpillars feeding anywhere except on the grape clusters, but the leaves and tendrils have been recorded in their menu at this time. In a few instances we have found where the caterpillars had burrowed into the fruit stem causing the end of the cluster to die, but their usual menu in June consists of the blossoms and young grape berries. The caterpillars of the European grape-berry moth have similar feeding habits in the spring.

It is an important fact that the first or spring brood of the caterpillars do not live inside the small blossoms and berries, but feed openly on the outside. For this offers a vulnerable point for effectively attacking the insect with a poison spray, as our experiments have shown.

By July 1, many of the caterpillars have attained their full size. They go onto the leaves where they make their peculiar cocoons, as shown in Fig. 22. A little flap is cut from the leaf and gradually pulled over and down and fastened to the leaf by silken threads. The inside is then lined with white silk, thus forming a snug cocoon. At the edge of a leaf, it is necessary to cut the flap only at the ends; but when the cocoon is made away from the edge, the flap must be cut along one side also, and frequently the caterpillar cuts along where the edge of the flap is to meet the leaf and pulls up the leaf a little to meet the flap. Fig. 22 well illustrates these variations in cocoon-making. In three or four days, the little caterpillar transforms inside its cocoon into the greenish-brown, mummy-like pupa stage (Fig. 21). During the first week in July, many of the spring brood of caterpillars pupated, and in from twelve to fourteen days the moths had developed and began to emerge. By means of the spines on its back (Fig. 21), the pupa is enabled to work its way nearly out of one end of its cocoon, and the moth then emerges leaving the empty pupa skin projecting from the cocoon.

We reared moths from caterpillars of the spring or June brood on July 16 to 18, but they must have begun to appear earlier, for recently-hatched caterpillars were found in the grapes in vineyards on July 14.

*The summer brood and its habits.*—During July and August all of the four stages of the grape-berry moth can be found in the vineyards at the same

time, for the different broods overlap. What may be termed the second or summer brood of caterpillars works during the latter half of July and in August.

The July moths or parents of this brood lay their eggs on the skin of the green berries or on the stems.\* The embryo caterpillars can be seen through the semi-transparent shell of the egg, as shown in Fig. 16. Several eggs may be laid on the same grape, and are quite easily found. We seem to have been the first to find them. The number of eggs a moth may lay has not been determined, nor the duration of the egg-stage. The European grape-berry moth is estimated to lay from 20 to 40 eggs which hatch in about a week.

A caterpillar which we saw hatch about 5:00 P. M., on July 26, wandered around on the grape-berry for nearly seventeen hours when it finally gnawed its way into the fruit at the point where the stem is attached. It fed inside the same grape until its death August 13, when it was about half-grown. Many of the newly-hatched caterpillars enter where berries touch each other. A dark-reddish spot soon appears on the green fruits around the entrance hole, and as the caterpillar feeds in the pulp this dark spot enlarges until nearly half of the berry is often involved. The young caterpillars are whitish with a blackish head. As they grow, the shield on the thorax and the six true legs become blackish, and the whole body changes to a dark green, often with a purplish tinge (Fig. 18). The caterpillars are very active and when disturbed quickly wriggle out of the grapes and suspend themselves by a silken thread.

In our cages, caterpillars which hatched about July 25, got their growth inside the grapes in three weeks and spun their cocoons August 17. Many of the moths developed from this second or summer brood of caterpillars in the grapes emerged from August 15 to 28 in our cages.

The most conspicuous and destructive work of the grape-berry moth is done by this second and most numerous brood of caterpillars working in the growing, green grapes in July and August. Vineyardists can readily see the characteristic purplish spots on the infested fruits, which often crack open at this point (Fig. 13), and thus afford an ideal lodging place for the spores of the destructive rot fungi. In some badly infested vineyards we found many clusters with over three-fourths of the berries infested. Oftentimes the caterpillar goes from one berry to another, fastening them together with a few silken threads. To determine how many berries one caterpillar usually spoils, we put in our cages on July 30, two clusters each containing 17 grapes infested by young caterpillars; by August 15, there were 25 and 29 "wormy" grapes in the clusters. This experiment and other observations indicate that one caterpillar rarely destroys more than two green grapes in summer, and one berry often furnishes sufficient food. Every infested berry helps to spoil the symmetry of the clusters and necessitates the labor of removing such berries before marketing the crop, except where they can be sold cheap for wine. Several vineyardists have demonstrated the practicability of picking off the infested green berries when they are conspicuous in August.

\* The thin, rounded, scale-like, semi-transparent eggs measure .6 to .8 by .7 to .9 millimeters in size, and appear whitish in a few days. The shell is finely reticulated, as shown in Fig. 16, and the egg appears to be glued to the fruit by some substance. The eggs look much like a codling-moth's egg, only smaller.



FIG. 13.—Cluster of green Concord grapes badly infested by the grape-berry moth, natural size. Note the discoloration and cracking open of the infested berries; the round, white eggs of the insect can be seen on some of the fruits.



FIG. 14.—The grape-berry moth caterpillar and its work in the pulp and seeds, enlarged.

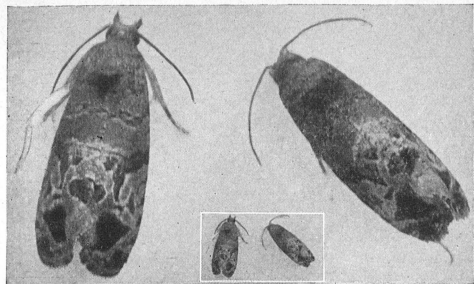


FIG. 15.—American grape-berry moths at rest, natural size and enlarged.

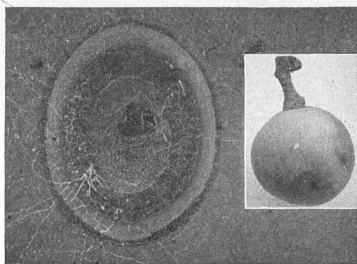


FIG. 16.—Eggs, natural size on the grape, and enlarged.

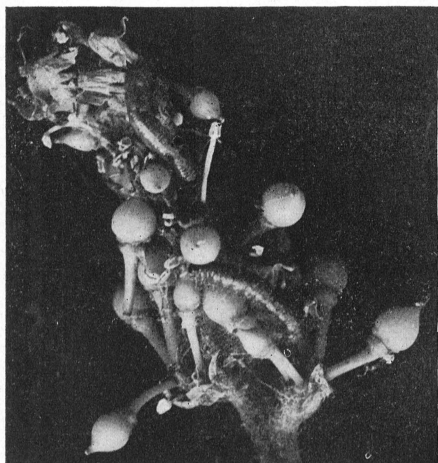


FIG. 17.—Grape-berry moth caterpillars working among young fruits, twice natural size.

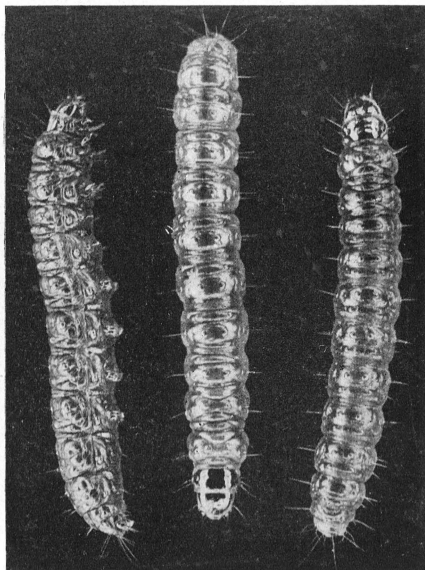


FIG. 18.—Grape-berry moth caterpillars, enlarged.

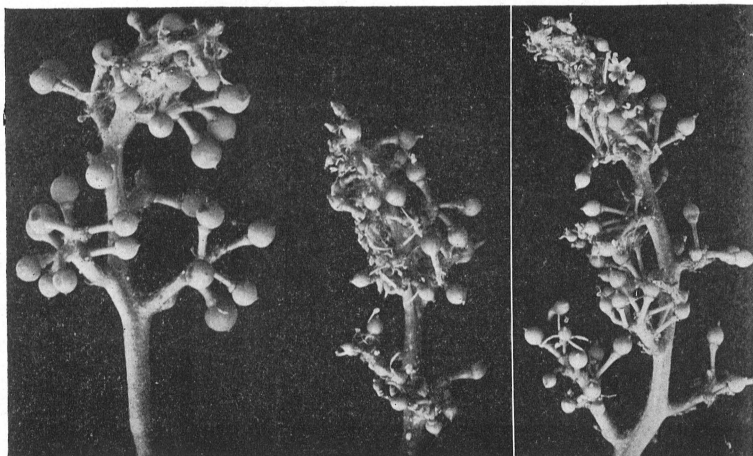


FIG. 19.—Work of spring brood of grape-berry moth caterpillars among blossoms and young fruits in June, natural size.

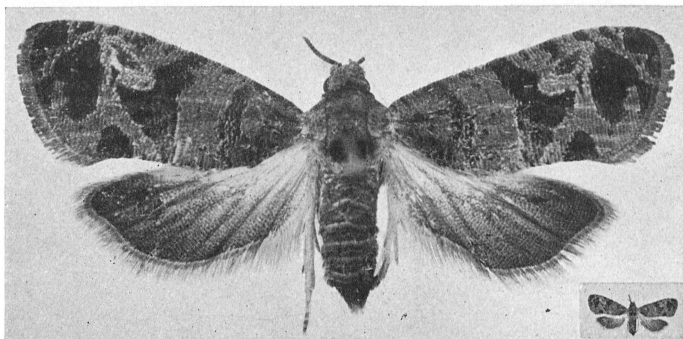


FIG. 20.—*American grape-berry moth*, enlarged ; shown natural size in lower corner.

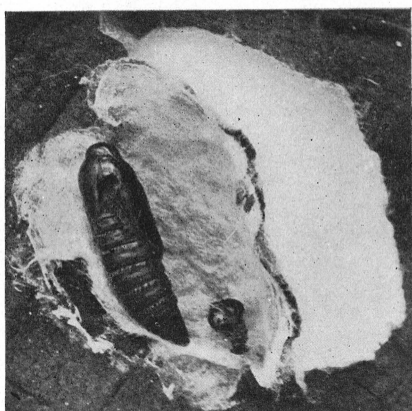


FIG. 21.—*Grape-berry moth pupa in its cocoon on flap of leaf*, enlarged.

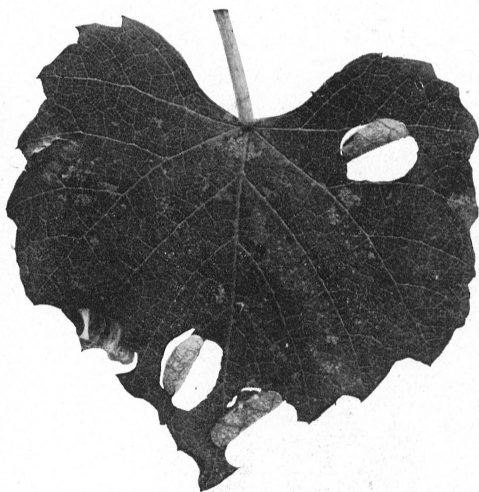


FIG. 22.—*Grape leaf showing cocoons in the making and finished by grape-berry moth caterpillars*, natural size.

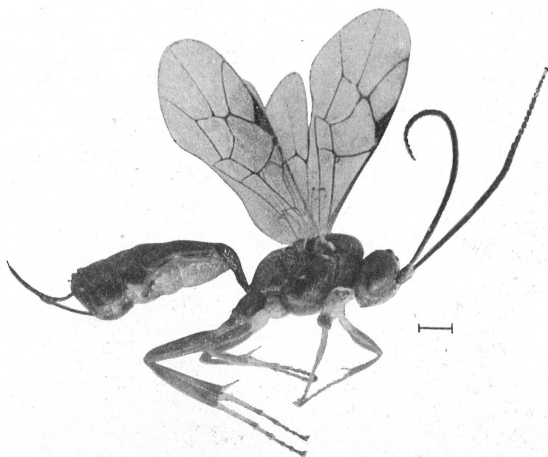
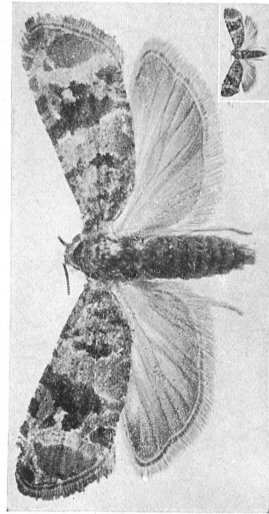
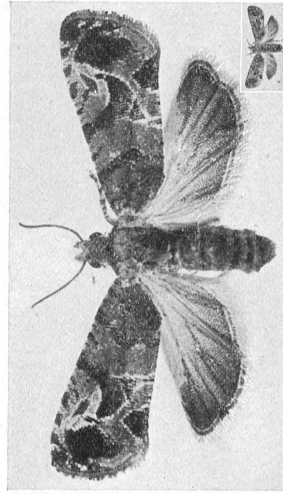


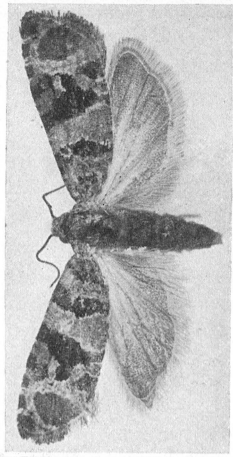
FIG. 23.—*Thymarisc slingerlandana* Ashmead, a common parasite of the grape-berry moth. Enlarged, the hair-line showing its natural length.



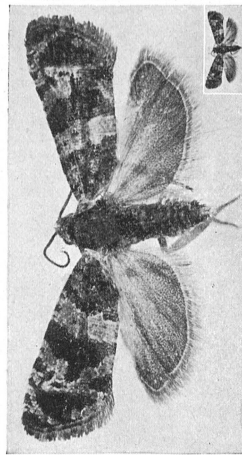
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*Polychrosis botrana* Schiffermüller.



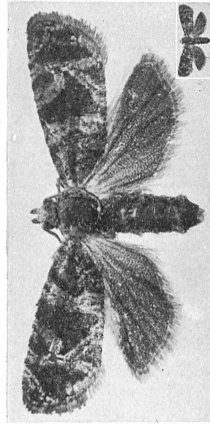
American  
*Polychrosis vitana* Clemens.



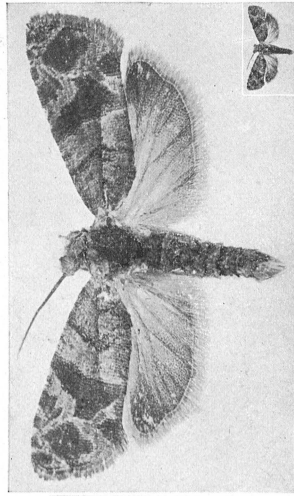
European  
*Polychrosis botrana* Schiffermüller.



*Polychrosis rhoifructana* Kearfott.



*Polychrosis slingerlandana* Kearfott.



*Polychrosis liriodendrana* Kearfott.

FIG. 24.—The European and American grape-berry moths compared, and pictures of three new species of moths allied to and heretofore confused with the American grape-berry moth.

When the summer brood of caterpillars get full-grown in August, they all go onto the leaves and cut out their characteristic cocoons, as shown in Fig. 22. In our cages the caterpillars would wait for several days and sometimes die before transforming, if leaves were not supplied them for cocoon-making.\*

*A partial third brood in autumn.*—By August 1, many of the caterpillars of the second brood have changed to pupæ in their cocoons on the leaves. In from 12 to 14 days the pupæ transform and the moths emerge. We reared many moths from August 15 to 20 and most of them emerged in the forenoon, but all came from cocoons made before August 15. It seems that all caterpillars of the summer brood which pupate after about the middle August do not transform to the moth state that year. In other words, part of the second brood of pupæ hibernate, and part develop into moths to produce a partial third or autumn brood of caterpillars which work in the ripening grapes. This third brood is not nearly so large as the second, and as many of the fruits infested by the latter drop off before the fruit ripens, oftentimes the infestation does not seem as bad at picking time as in August, but the clusters are more ragged. Most of the caterpillars are full-grown before October 1, but some were found working in very ripe fruit two weeks later. A few caterpillars transform in autumn to pupæ inside the berries they infest, but most of them make their characteristic cocoons on the leaves, like the earlier broods. Our observations indicate that the insect always passes the winter in the pupa state in its cocoon on the fallen leaves near the vines.

The European grape-berry moth has three broods in Italy and its habits are very similar to the American insect during the growing season. But in autumn the European caterpillars, instead of making their hibernating cocoons on the leaves or in the fruits, as they do in summer, go onto the trunks of the vines and the stakes or trellis posts, where underneath the bark they make their thicker, winter cocoons. We failed to find any hibernating cocoons of the American insect in New York vineyards except on the fallen leaves.

#### THE NATURAL ENEMIES OF THE GRAPE-BERRY MOTH

Fortunately for the vineyardist, we have discovered that the grape-berry moth has many enemies among its own kind, which play a very important part in its "ups and downs." Undoubtedly these insect enemies, aided by winter weather conditions, are largely responsible for the comparatively small size of the spring brood of this grape pest.

In August, 1903, several caterpillars were found in the grape berries that were being attacked externally by a small whitish maggot, which soon spun a

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\* The pupæ are 5 millimeters ( $\frac{3}{16}$  inch) in length and of a light greenish-brown color, with eyes and caudal border of abdominal segments and last two or three segments darker brown. There is a row of coarse, short spines near the cephalic border, and a row of finer ones along the caudal border of the dorsum of each abdominal segment; and eight bristles with recurved tips for hooking into the silken cocoon occur around the tip of the abdomen.

little, white, silken cocoon after sapping the life of its victim. From several of the cocoons kept in our breeding cages during the next winter, there emerged in May and June two kinds of little parasitic flies instead of the expected grape-berry moths. Then in the spring of 1904, we found in the webbed blossom-clusters several cocoons of another parasite, which had doubtless destroyed the caterpillars feeding on the blossoms. Later that season, we found that many of the caterpillars of the second or summer brood never developed into the moths, for little parasitic flies came for their cocoons in August.

The grape-berry moth is therefore beset by insect enemies during the development of each brood and at all seasons of the year. We have bred the unusually large number of six different kinds of parasitic flies, which must materially help the vineyardist in his warfare against this enemy. This was a surprising discovery, for heretofore only a single enemy of this grape pest had been recorded in America.\* Four of these parasites are little Ichneumon flies and two are Braconids. Four of them were not new to science, but one, and possibly two, proved to be new species. The one which we reared in largest numbers and which thus seems to be the most effective check on the grape-berry moth has been burdened with our name. It is now known to science as *Thymariscus slingerlandana* Ashm. and is shown much enlarged in Fig. 23. Dr. Ashmead reports that this is the first American species to be described in this genus.

The following notes regarding these parasitic enemies of the grape-berry moth are worth recording:

In 1869, Riley found two maggots destroying the caterpillars in Missouri, but he failed to breed the adult parasite. We find no other record of any enemy of the insect in America. Riley's description of the habits of this parasite does not fit any of those we have seen, but comes nearest to one of the Braconids.

*Bracon scrutator* Say. (Boston Journ. Nat. Hist., I, 254). The maggot of this little Braconid parasite seems to feed externally on the nearly full-grown caterpillars of the second brood at work in the green fruit in August. Their little, white cocoons are spun in the infested berries. The adults emerged in about two weeks on the following dates: Aug. 28, Sept. 1, 4 and 10.

*Bathymetis* sp. near *terminalis* Ashm. We reared two females of this comparatively large parasite (Fig. 12, p. 43) from hibernated pupæ on May 31. The grape-berry moth caterpillar had pupated and the parasite's cocoon filled that of its host. Dr. Ashmead reports our specimens as probably undescribed, but possibly *terminalis*, which was described from a male only.

*Glypta animosa* Cress. (Trans. Am. Ent. Soc., III, 154). One specimen of this

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\*Two parasites, a Pimplid (*Phytodietus pleuralis* Cress.) and a Braconid (*Bracon vernoninae* Ashm.) have been recorded (Insect Life, II, 349 and III, 404) on *Eudemis botrana* in this country. But the former was bred from tulip-tree and the latter from seed capsules of *Vernonia*; and the host insects feeding on these plants are now believed to be distinct species from either the European or the American grape-berry moths. The one working on tulip-tree leaves is described on page 58 as *Polychrosis liriodendrana* by Mr. Kearfott. However, it is quite probable that these two parasites also include the American grape-berry moth among their hosts, and thus should be added to the list of its insect enemies.

Ichneumon emerged from an over-wintered cocoon on June 4. It spun a very thin cocoon and had evidently killed the caterpillar, as no trace of a pupa was found. The recorded hosts of this parasite are *Paedisca scudderiana*, two other Tortricids and a Pyralid.

*Glypta vulgaris* Cress. (Trans. Am. Ent. Soc., III, 157). Two specimens of this common parasite emerged on August 25 and 27 from thin, white cocoons nearly filling their host's cocoon in a wild grape. Like *Glypta animosa*, this species evidently kills the caterpillar, but it works on the summer brood. It is also parasitic on a species of *Gelechia* and on a Pyralid (*Margaronia quadristigmalis*).

*Urogaster canarsiae* Ashm. (Ent. Soc. Wash., IV, 127, with figure). Found the cocoons of this probable parasite in the webbed blossoms where grape-berry moth caterpillars had worked. Two specimens emerged on July 3 and 7. Evidently parasitic on the first or spring brood. Its other known host is the Pyralid (*Canarsia hammondi*).

*Thymaris slingerlandana* Ashm. (Can. Ent., XXXVI, Nov., p. 333). From August 15 to 27, we reared 17 specimens of this little back Ichneumon with orange-colored, light yellow-banded legs from the cocoons of the grape-berry moths working in both wild and cultivated grapes. Its cocoon occupies about half the space inside the host's cocoon, and evidently the caterpillar was its victim.

The European grape-berry moth (*Polychrosis botrana*) is preyed upon by eight Ichneumons closely allied to our American parasites, one Dipteron, one spider and two fungous diseases (Nuove Relazioni R. Stazione di Entomologia Agraria di Firenze, Serie Prima, No. 1, p. 152-162).

#### REMEDIAL TREATMENT FOR THE GRAPE-BERRY MOTH

At least three times during its yearly life-cycle, this insect is vulnerable and can be effectively fought.

*Destruction of fallen leaves.*—The most frequent recommendation has been to gather and burn the fallen leaves in autumn or winter, and thus destroy the insect in hibernation as a pupa in its cocoon on the leaves. This method is correct in theory and practicable on a small scale, and might help materially in controlling the insect. But our experience in hunting for the hibernating cocoons indicates that many soon break loose from the fallen and rotting leaves on the ground, and thus are not carried by the wind with the drier leaves into the piles which usually accumulate. The failure also of some to breed the moths from leaves, probably collected from piles in infested vineyards, leads us to rank this among the least effective methods, and one often impracticable in a large vineyard.

By cultivating early, especially along the trellis under the vines, one would doubtless bury and destroy some of the hibernating pupæ.

*Bagging the clusters.*—The practice of putting paper bags around each cluster of grapes soon after they set, will doubtless protect them from attack by the second and third broods of the insect, as well as from other insects and the rot fungi. Hundreds of thousands of choice grape clusters are thus "bagged" every year in New York vineyards, and it pays.

*Picking the infested berries in August.*—Probably the method most often used against the grape-berry moth is to pick off and destroy the characteristic and conspicuous, spotted green fruits infested by the caterpillars. This destroys the very destructive second brood, thus preventing the further

development of the insect that season, and it is a very effective method. To test the practicability of this hand-picking method on large areas, some of the Chautauqua vineyardists coöperated with us and made the experiment in 1903 and 1904. It was found to cost only about \$2.00 to thus go over an acre of vineyard and pick off the infested fruits in August. An acre yielded from 30 to 50 pounds of "wormy" grapes. The expense was small for such a very effective method. Boys and girls could do the work well and cheaply, and we strongly commend this sure method, especially as the infestation is usually serious only over a portion of a vineyard.

*Destruction of "trimmings."*—Oftentimes the grapes are sorted and "trimmed" for the market in the vineyard. All the "wormy" or bad berries are removed and often left on the ground where the "worms" can develop into a destructive crop of the insect for the next season. Many a local infestation in a vineyard doubtless can be traced back to such packing or sorting spots. Care should be taken to collect and bury or burn all such "trimmings" from the grape clusters. It will repay the slight extra expense many times over.

*Destroying sumac and other supposed food-plants.*—That part of a vineyard nearest woodlands, or perhaps a lot of sumac, is oftentimes more infested by the grape-berry moth. And as the insect was supposed to breed in sumac seed-bunches and on various other plants, some have considered the destruction of such plants a helpful remedial measure. But we have shown in discussing the food-plants of this insect, that it now seems quite probable that it feeds exclusively on grapes. Undoubtedly a large clump of sumac or other plants, or an old brush-grown fence, near a vineyard would afford a convenient place for a pile of grape leaves to accumulate, and thus might afford the insect better hibernating quarters. The removal of such useless plants or unsightly fences near vineyards is always advisable, but it may help but little in reducing the numbers of the grape-berry moth.

*Poison sprays are effective.*—About nine years ago, the use of a poison spray was suggested for combating this insect.\* It was said to be practicable only against the first brood, which was supposed to develop on the green parts of the vine, and here the results would be doubtful, for the insect was more than likely to breed on a great variety of foliage, and thus spraying would not afford much protection. By 1898, however, the vineyardists of northern Ohio, who were then fighting the grape root-worm, had found that they were controlling the grape-berry moth by spraying with poisons early in the season, soon after the grapes had set, when the first brood of caterpillars work on the outside.†

The vineyardists in Chautauqua County who coöperated with us in the experiments in picking off and destroying the infested green berries in August, also sprayed infested parts of their vineyards in 1903, and during the

\*Marlatt in Yearbook of the U. S. Dept. of Agriculture for 1895, p. 404.

†Webster in Rept. Ohio Hort. Soc., for 1898, p. 3.

past season with the arsenate of lead. In one case the poison was applied at the rate of 10 and 12 pounds in 100 gallons water, the first application being made just before the blossoms opened, a second application just after the petals of the blossoms fell, and a third when the berries were about the size of small peas. The vineyardist reported that these applications gave almost absolute protection from the insect during the rest of the season. Another grower who sprayed a little later this season with "Disparene" at the rate of 8 pounds in 90 gallons of Bordeaux mixture reports very few "wormy" grapes. Dr. Felt also reports 50 per cent less fruit damaged by grape-berry moths where arsenate of lead and also a poisoned Bordeaux mixture was applied in 1903 for the grape root-worm beetles shortly after blossoming and while the fruit was not larger than a small pea.\*

The above evidence in favor of the effectiveness of a poison spray for the grape-berry moth leads us to strongly advise its use in infested vineyards. Probably any of the standard poison sprays will do effective work, but we like the arsenate of lead best. With this poison there is no danger of injuring any part of the vine; it sticks on longer than other poison sprays; and we have demonstrated its effectiveness against the grape root-worm beetles (Bull. 224) which need to be fought about the same time as the grape-berry moth. Thus with this poison spray, the vineyardist can hit two serious insect enemies at the same time, and by combining the arsenate of lead with Bordeaux mixture, a very effective blow can be dealt to rot and other fungous troubles.

The poison spray is effective only against the spring brood of caterpillars working in the blossoms and recently-set fruit clusters where they must work on the outside, and can thus eat the poison. Two applications are advised, at the rate of about 4 pounds of the arsenate of lead or "Disparene" in 50 gallons of water or Bordeaux mixture. Spray first just before the grape blossoms open in the latter part of June, make a second application just after the petals of the blossoms fall. Doubtless a third application of the poison will pay when the berries are about the size of grape-seeds. Only thorough work will pay in spraying vineyards. Aim to cover every fruit cluster and all the foliage with the poison and Bordeaux, thus hitting the grape-berry moth caterpillars and rot fungi on the clusters, and the root-worm beetles and mildews on the leaves.

*European methods.*—The closely allied grape-berry moth which infests European vineyards does not differ in its feeding habits from the American species, so the same remedial measures should prove effective during the growing season. Laborers in Europe are sometimes trained to carefully pick out or crush the first brood of caterpillars working in the blossom clusters. This is practicable in our country when very observant help is obtainable. Hand-picking of infested green grapes later in the season is also much practiced in Europe.

A spray of soft soap, alcohol, and benzine is strongly recommended in Europe for hitting and killing the caterpillars in their webs among the blossoms in spring. Others report

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\*Bull. 72, N. Y. State Museum, p. 31 (1903).

good results with a 3 per cent soap solution. The former would be too expensive a spray for American vineyards, and our cheaper poison spray is also very effective against some of the other enemies at the same time.

As the European insect hibernates in cocoons on the trunks of the vines and on the trellis posts, it is effectively combated by stripping off the loose bark in winter and destroying the pupæ on this and in all cracks or similar places. This method is not applicable in America for our insect does not hibernate in such places, but on the ground on the widely-scattered leaves.

#### COMPARATIVE NOTES ON THE AMERICAN AND EUROPEAN GRAPE-BERRY MOTHS

In 1860, Clemens (Proc. Acad. Nat. Sci. of Phila., p. 369) named some moths *Endopiza? viteana* which he reared from caterpillars feeding on grape-berries, wild raspberry fruits, and leaves of sassafras. About eight years later, the grape-feeder attained the rank of a serious pest in vineyards, and two other names were suggested for it. Rathvon (Prac. Farmer, Nov. and Dec., 1868, p. 170 and 48) called it the grape codling-moth (*Carpocapsa vitisella*) and Packard gave it the name of *Penthina vitivorana* (Guide the Study of Insects, p. 336). In 1870, however, Riley sent specimens to Zeller in Prussia, and he said they were identical with the European grape-berry moth (*Eudemis botrana* Schiff.), thus relegating the American names into the synonymy where they have since remained undisturbed. As soon as we found that the insect infesting New York grape-berries was not following the scheduled life-history of the European pest, doubts at once arose regarding the identity of the American and European grape-berry moths in spite of Zeller's dictum which had stood unquestioned for over thirty years. Several authentic specimens of the European moths were obtained and have been critically compared by an expert, Mr. W. D. Kearfott, with dozens of the moths reared from American grapes, both wild and cultivated, and also with the type specimens of Clemens's *viteana* and some of Riley's material. Briefly stated, the conclusion is that the American grape-berry moth is Clemens's *viteana* which is distinct and easily separable from the European insect. This conclusion, based on a comparison of the moths alone, is strongly supported by our observations on the difference in the life-history of the two insects, and the fact that the American insect freely infests both our wild and cultivated grapes.

The general coloration of the moth of the European insect (Fig. 24) is a nashy gray with pale grayish hind wings, while the American moths range a trifle smaller, and are of a general purplish-brown color with smoky-brown hind wings. And the large outer marginal patch near the fringe of the front wings affords a sure and easy distinguishing mark between the two insects. In the European *botrana*, the outer edge of this pale olive-green patch is rounded and not indented below, while in the American *viteana* this dark-brown patch is indented above the anal angle by a spur of the lighter ground color of the wing. This characteristic difference is well shown in Fig 24. There is considerable variation in the indentation of this patch in *viteana* but it is always present; we have a few specimens where the indentation extends through the patch, thus making it smaller and separating off a narrow strip of it on the edge of the wing, but this usually occurs on one wing only, the other being nearly normally indented. Superficially the two insects are marked much alike, but are easily distinguished by the characteristic differences in general coloration and the outer marginal patch. Both species are somewhat variable in size and markings, as is shown in Figs. 20 and 24.

An excellent, detailed, 75-page account by G. Del Guercio of the European grape-berry moth was published in 1889 (Nuove Relazioni R. Stazione di Entomologia Agraria di Firenze, Serie Prima, No. 1, p. 117-193). In a careful comparison of specimens of the early stages of our American species with Guercio's descriptions, we found but few minor differences.

DESCRIPTIVE NOTES ON SOME NEW SPECIES OF AMERICAN MOTHS THAT HAVE  
BEEN CONFUSED WITH THE GRAPE-BERRY MOTH

BY W. D. KEARFOTT

The following notes are from breeding records extending over the past four years, which have convinced me that each of the species described, as well as a number of others waiting for better material, completes its entire yearly cycle of two or three broods on a single food-plant, and also with little doubt each food-plant supports a separate and distinct species. This does not seem unreasonable, for in Europe there are twenty described species in the genus *Polychrosis*.

*Synopsis of species.*—

- 1 With large outer marginal patch of front wing indented above anal angle by a spur of ground color.....2  
With this patch evenly rounded on outer edge, not indented below .....*botrana*
- 2 With inner half of front wing uniformly lilaceous or leaden-blue, crossed by well defined narrow brown lines.....3  
With inner half much mottled with reddish-brown or gray .....4
- 3 With ground color of outer half of front wing rich ochreous-brown....*liriodendrana*  
With ground color of outer half of front wing pale yellowish-brown .....*viteana*
- 4 With dark color of central fascia of front wing extending to dorsal or inner margin .....*rhoifructana*  
With this dark color concentrated about and above middle of wing, and not reaching dorsal or inner margin.....*stingerlandana*

It is not unlikely that the European *botrana* is or may become established in America, although of all the specimens examined I have not seen a single one that could be referred to it, hence it is included in the synopsis and a brief description added. On the other hand it would not be surprising if the American *viteana* should at some time be introduced into Europe.

*Polychrosis botrana* Schiffermüller.—Front wing; ground color ashy-gray, with a pale olive-green lunate spot or patch on outer end of wing; the inside edge of this spot nearly straight, and outer edge evenly rounded and its lower half defined by cilia. Just beyond middle of wing is an irregular fascia, shaped much like outline map of South America, pale olive-green on inner and lower area, and replaced by velvety black on outer and upper area. A narrow fascia of olive-green crosses wing half way between central fascia and base, and between the narrow fascia and base are two abbreviated narrow fascia arising from dorsal margin and terminating at middle of wing, these bands are more or less overlaid with black scales. Five, large, well rounded, costal spots on outer half of wing, the outer one in the apex, and inner in central fascia; and there are several smaller, black, costal dots on inner half of the costa. The costa is very narrowly edged with white. Hind wing; very pale gray, a shade darker at apex. Expanse 12 to 13 mm.

*Polychrosis viteana* Clemens. Front wing; ground color, lilaceous or leaden-blue. The outer marginal patch is sharply indented above the anal angle by a spur of the ground color, the inner edge is less straight than *botrana* and bulges inward at middle of wing; the color is dark brown. The central fascia is more slender than *botrana*, its outer spur is sharply produced in some specimens turning upwards towards costa, and almost joining submarginal patch. The inner fascia is narrower than *botrana*, and the two short inner dorsal fasciae are only indicated by a few brown scales. Apical spot is larger than *botrana*, and there are three smaller, rectangular, oblique spots on costa beyond the central fascia. The inner spot, which in *botrana* is as distinctly defined as the other four, is in *viteana* not separable from central fascia. A few short streaks on costa before the middle. A shade of pale yellowish-brown, involves the outer half of costa between the central fascia and outer patch, giving the outer half of wing this color. Hind wing; smoky-brown becoming paler at base. Expanse 10 to 11.5 mm.

The many specimens bred by Professor Slingerland of the three broods on cultivated grape, and one or more broods on wild grape are remarkably uniform in coloration and maculation, and I have not observed a single specimen that varies sufficiently to form a connecting link between any two of the five species here treated.

Larva; 9 to 10 mm. cylindrical, rather robust, tapering from 4 to head and from 8 to anal segment. Pale, olivaceous green, with a reddish or purplish tinge from food within. Head flattened, slightly bilobed, luteous green on upper parts of lobes, discolored by brown in front. Mouth parts, and a horizontal dash on each side of lobe below middle, black. Prothoracic shield large, but narrow, luteous brown, bisected by pale green dorsal line. Thoracic feet black, green between the joints. Tubercular plates moderate, a slight shade darker than skin, shining. Anal plate not chitinous.

*Polychrosis liriodendrana* Kearfott.—(Trans. Am. Ent. Soc., Dec., 1904). Front wing; ground color, lilaceous or leaden-blue, much as *viteana*, but extending farther outward and involving a greater area of wing; the bands and spots in this species are nearly uniformly an ochreous olive-brown, a little paler around the edges, but with hardly a trace of black which is so characteristic of *viteana*. The outer patch is almost square, much smaller than the two preceding species. The outer spur of the central fascia is less produced than *viteana*, its upper limb is broader, and it is considerably broader on and above dorsal margin. The narrow fascia at inner third is more sharply angulated at middle than either *botrana* or *viteana* and in some specimens is almost obsolete. Four, large, rectangular, costal spots, beyond middle, the outer one in the apex. A narrow, oblique streak before the inner spot turns upward and merges into this spot. The ochreous-olive shade is most apparent on outer third of wing. Hind wing; darker, smoky-brown than *viteana* and less pale at base. Expanse 11.5 to 12.5 mm.

Larva; 10 to 11 mm. cylindrical, less robust than *viteana*, slightly tapering, sordid green. Head yellowish-brown, ocellic field and lateral dash on lobes black. Mouth parts only slightly darker than head; pro-thoracic shield dark brown; thoracic legs black. Tubercular plates, concolorous, slightly shining. Anal shield not chitinous.

The larva makes a narrow tent along one side of the midrib beginning near the base on the under side of the leaves of *Liriodendron tulipifera*, sometimes tunnelling the midrib for a length of 15 to 20 mm. As it increases in size, the tent is widened, until at maturity a whole lobe of a leaf may be involved; rarely more than one on a single leaf. Spring or first brood not observed. Second brood, full-grown larvæ July 2 to 9; moths issued July 10 to 21. Third brood of larvæ from Sept. 15 to Oct. 15; hibernates as pupæ in the same form of cases as *viteana*.

*Polychrosis slingerlandana* Kearfott.—(Trans. Am. Ent. Soc., Dec., 1904.) Front wing; ground color, mottled shades of ochreous light-brown and dark-brown, the leaden-lilaceous blue is nearly obsolete, occurring only as a ciliate band and a few scattered scales in basal third and streaks in outer third.

The patches and fasciæ of the preceding species are in *slingerlandana* very illy defined and are much more clearly apparent in Fig. 24 than in the actual specimens owing to the absence of true color values in photographs. The outer patch is of rather triangular shape, nearly straight on inner edge and sharply indented above anal angle. The central fascia is nearly of corresponding shape. At the end of cell, below costa, is a flattened ovate patch of light brown and a spot of similar color on dorsum just before middle. The costal spots are not as clearly defined as in any of the preceding species, and are pale brown, each divided (geminated) by a short streak of black. Hind wing; very dark, smoky-black. Expanse 9.5 to 10.5 mm.

Larva on *Eupatorium perfoliatum*; 8 to 9 mm.; cylindrical, more robust than *viteana* or *liriodendrana*, slightly tapering, olive-green. Head, flattened, chestnut brown, mouth-parts darker brown, ocellic field, lateral dashes and thoracic feet dark brown. Pro-thoracic shield light chestnut-brown darker shaded on posterior edge. Tubercular plates moderate, nearly concolorous, shining. Anal shield not chitinous.

First brood not observed. Second brood; larvæ, July 6 and 9 (Montclair, N. J.) in young flower-heads, tunnelling a passage, slightly silk lined. Moths issued Aug. 5 and 7. Third brood in mature flower-heads, tunnelling as before, and feeding on seeds and flowers, Sept. 7 to 20. Hibernates as pupæ, formed in cases cut out of a leaf same as in preceding species.

*Polychrosis rhoifractana* Kearfott.—(Trans. Am. Ent. Soc., Dec., 1904.) This species is nearest to *slingerlandana*, as it is much darker and more mottled than the first three species here treated, but its fasciæ and spots are much more sharply outlined. Front wing; outer patch, as in *slingerlandana*, merging into costal spot, but more flattened laterally and more rounded at apex. Central fascia with outer spur broader and more obtuse at its end. Between this central dark fascia and the dark narrow fascia at inner fourth, is a well defined pale brownish-gray fascia, slightly darker above than below the middle. The ground color of this species is more pronouncedly pale brown and whitish-gray than in any of the four preceding; with the darker olive-green and greenish-black spots and fasciæ well defined. A flattened, triangular patch of this ground color lays on the costa between middle and apex and contains the dark costal spots, of which the apical is rounded, the inner one rather large and rectangular, and the two intermediate smaller and triangular. Hind wing; pale gray, darker at apex and outer margin. Expanse 10.5 to 11.5 mm.

I have not bred this species. It has been bred in the insectary, Wooster, Ohio, from seed racemes of sumac; all of the specimens observed were forced, dates of emergence being Dec. 28 to Mar. 6. In the U. S. National Museum are some specimens that I refer to this species with considerable doubt; Prof. Riley's unpublished notes state that they were "Sumac leaf-rollers." The specimens look much like *viteana*, and I am inclined to think sumac and grape larvæ have been mixed, especially as the well-known Sumac leaf-roller is an entirely different species and genus of Tortricid, namely, *Episimus argutanus* Clem.

#### NOTES ON THE RED-BANDED LEAF-ROLLER (*Eulia triferana* Walk.) THAT SOMETIMES WORKS WITH THE GRAPE-BERRY MOTH

While observing the work of the spring brood of the grape-berry moth caterpillars on the clusters of blossoms and recently-set fruits in June, a larger green caterpillar was quite often found at the same destructive work. The full-grown caterpillar is shown in Fig. 25. It is about the color of the small green grapes on which it works and has a slightly brownish head; the young caterpillars are light yellowish. The blossoms and young fruits are webbed together and fed upon by the caterpillars. When full-grown they spun a light cocoon between two leaves and in three or four days transformed to brown pupæ, from which the reddish-brown, banded adults or moths, shown in Fig. 25, emerged in ten days or on July 16 and 19. We saw nothing more of the insect in the grape-berries during the season, but it may work as a leaf roller on the grape foliage. It is such a general feeder, that it probably will never become a serious vineyard pest.

This red-banded leaf-roller has been recorded as feeding on the following plants: cranberry, roses, clover, elm, soft maple, oak, apple, beans, strawberry, corn, *Gnaphalium polycephalum*, violets, chrysanthemum, Lobelia, honeysuckle, some other ornamental plants, and numerous field and garden crops. A moth in the National Museum Collection was bred from a caterpillar feeding on and boring into plums, which is not unlike its grape-berry eating habit. Mr. W. D. Kearfott has also reared the moths in August on narrow-leaf Solidago and Dogsbane, and from over-wintered pupæ in May on Sycamore and Apple. Surely this is a variable diet even for an insect.

One of the parasitic foes of the grape-berry moth also attacks this red-banded leaf-roller. It is *Urogaster canarsiae* Ashm. We reared one specimen on July 12.

The arsenate of lead poison spray, which our experiments indicate is so effective against the spring brood of the grape-berry moth, will also reach its comrade—this red-banded leaf-roller.

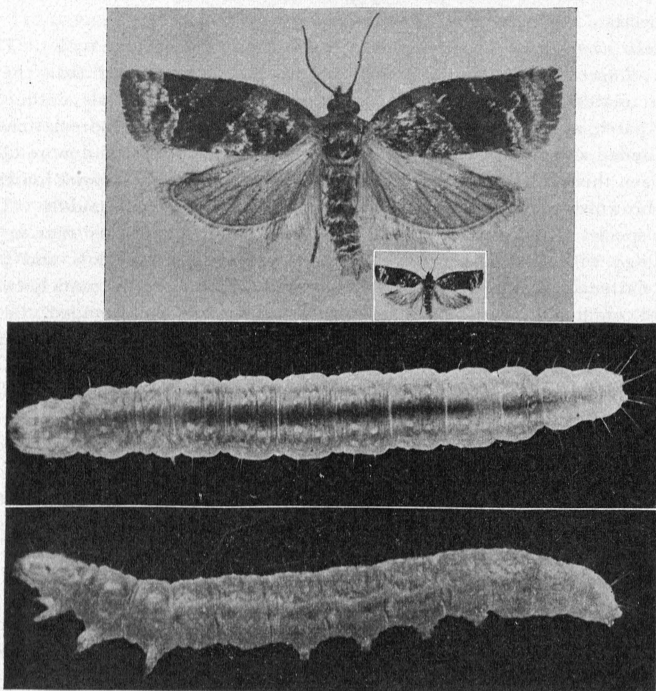


FIG. 25.—The red-banded leaf-roller (*Eulia triferana* Walk.), and its caterpillar, enlarged.

MARK VERNON SLINGERLAND.